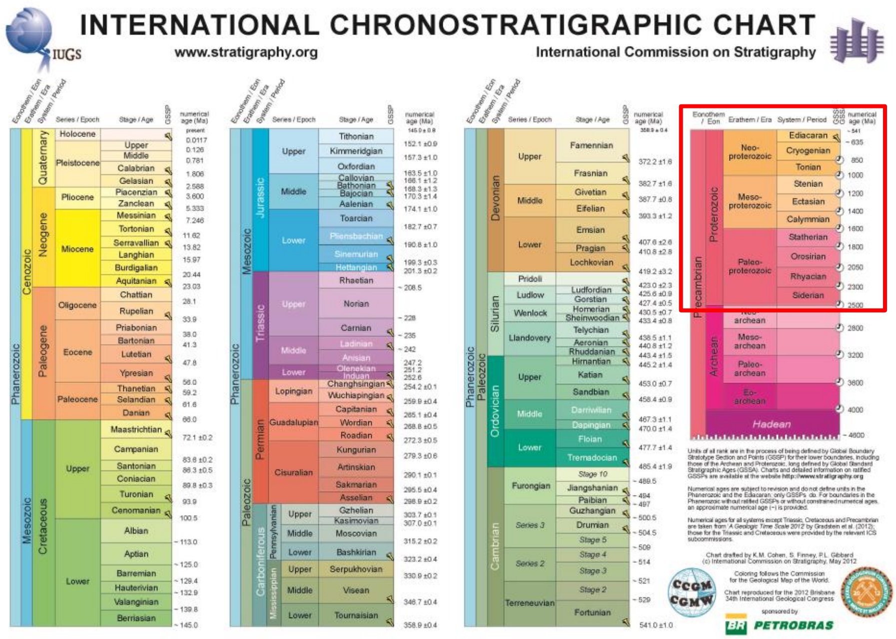
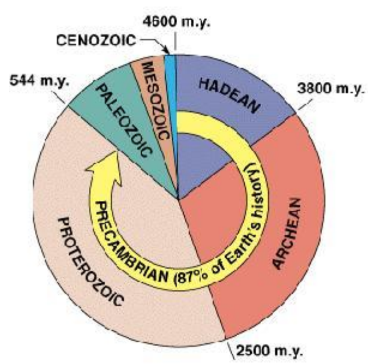
Proterozoikum

TABLE 6–2 Time Divisions for the Precambrian

Time in Billions of Years	Time Divisions Followed in This Book*	Events
	0.54	
	Late Proterozoic	Glaciation Grenville orogeny
1.0	1.0	
	Middle Proterozoic	
1.5	1.6	
2.0	Early Proterozoic	Red beds Glaciation
2.5	2.5	Kenoran orogeny
	Late Archean	
3.0	3.0	Earliest BIF
	Middle Archean	
	3.4	
3.5	Early Archean	
	3.8	Origin of life
4.0	Hadean	Oldest sediments Major outgassing Development of internal structure
4.5	4.6	Origin of Earth

*As recommended by the International Union of Geological Sciences.





The beginning of the Proterozoic Eon was marked by the appearance of the first continent-sized cratons and the beginning of a long-term rise in atmospheric oxygen. It ends with the widespread appearance of metazoan fossils. Currently, our coverage consists of an essay on the Cryogenian ice ages of the Middle Neoproterozoic, and a variety of materials on the Ediacaran Period, emphasizing the odd soft-bodied metazoan fauna of that time

Proterozoický eonotem (2.5-0.543 Ga)

Proterozoic rocks are easier to study than Archean rocks because they are less altered. But they are more difficult to study than Phanerozoic rocks because they lack the abundant fossils. Designation of the beginning of the Proterozoic at 2.5 by is somewhat arbitrary, but it marks:

1. Začátek **moderního stylu deskové tektoniky**. Lateral plate motion, subduction, rifting, and sea floor spreading.

2. Začátek **moderního stylu sedimentace**.
   Na kontinentech se vyvinuly široké **kontinentální šelfy**. Deposition of clastics and **carbonates** in shallow water.
   Tranistion from banded iron formations to red beds.

3. **Glaciace (zalednění) -** in both Early and Late Proterozoic (about 2.1 to 2.6 by, and later at 1.0 by to 0.54 by = 544 my).

4. **Nárůst volného kyslíku v atmosféře**
   Consequences of oxygen buildup:

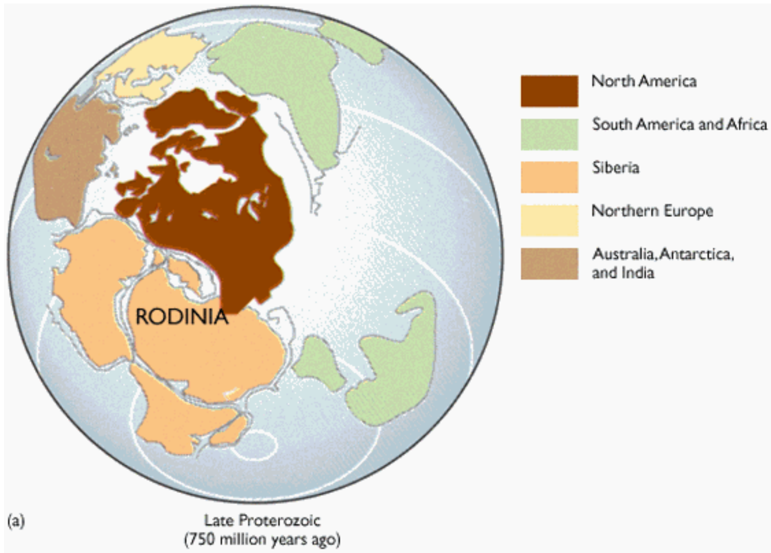
a. Rozvoj **ozónové vrstvy** which absorbs harmful UV radiation

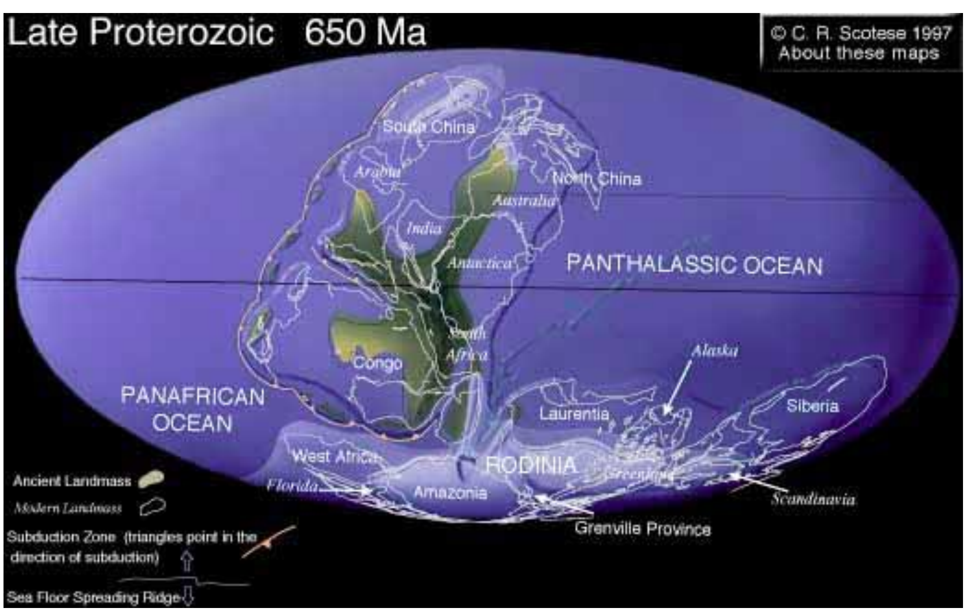
b. **Konec sedimentace páskovaných železných rud (banded iron formations)** which only formed in low, fluctuation O2

c. **Počátek sedimentace červených kontinentálních vrstev (red beds)** - red beds are clastic sedimentary rocks such as sandstones and siltstones with red iron oxide cement. The presence of iron oxide indicates that there was a relatively abundant, constant level of oxygen in the atmosphere at the time the rocks were deposited.

Globalni paleogeografie a tektonika

- Superkontinenty: Protopangea (Rodinie)
- Orogeneze:
  - grenvillská,
  - Panafricko-brazilská (kadomská)

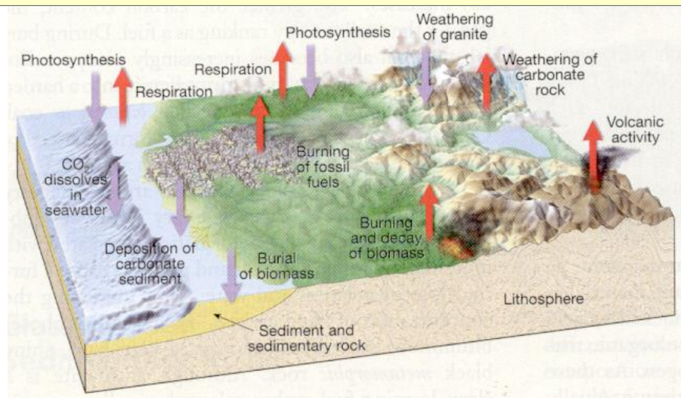

North America
South America and Africa
Siberia
Northern Europe
Australia, Antarctica, and India
RODINIA
(a)
Late Proterozoic
(750 million years ago)

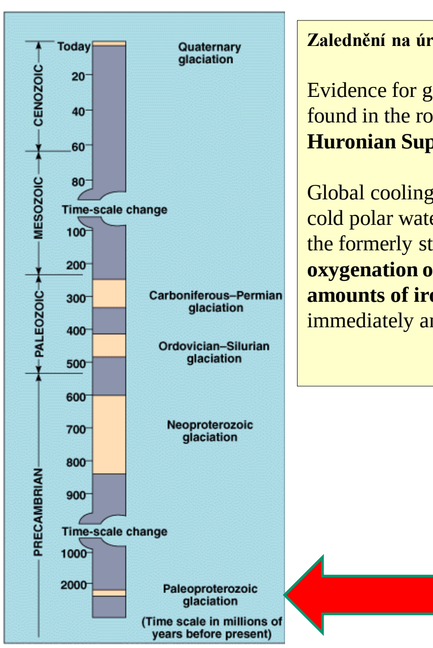

Late Proterozoic 650 Ma
© C. R. Scotese 1997
About these maps
South China
Arabia
North China
Australia
India
Antarctica
PANTHALASSIC OCEAN
South Africa
Congo
Alaska
PANAFRICAN OCEAN
Laurentia
Siberia
West Africa
RODINIA
Greenland
Florida
Amazonia
Scandinavia
Grenville Province
Ancient Landmass
Modern Landmass
Subduction Zone (triangles point in the direction of subduction)
Sea Floor Spreading Ridge

Uhlíkový cyklus a klima

Oxid uhličitý
By the early Proterozoic, large regions of continental shelf existed. These new expanses of shallow water covered with algal mats led to the production of extensive **carbonate platforms** (such as exist today in tropical regions - e.g. the Bahamas).

Carbonate formation, like photosynthesis, uses atmospheric CO_2 as the raw material. However, unlike the organic matter produced by photosythesis which is rapidly reoxidized, releasing CO_2 back into the atmosphere, carbonate is deposited as sedimentary rock, removing the CO_2 for geological spans of time. Thus the growth of carbonate platforms led to a decline in atmospheric CO_2 and a decrease in the global greenhouse.

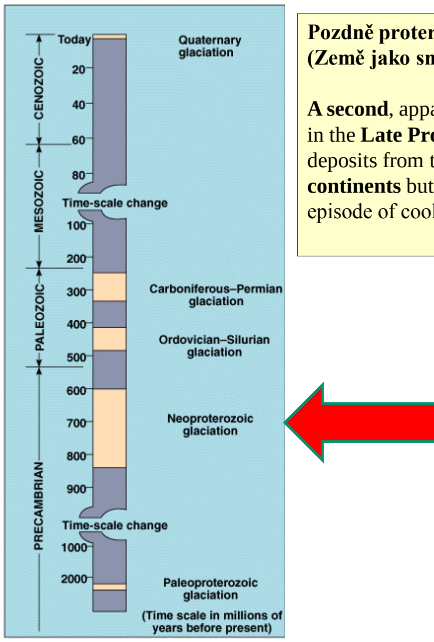




Zalednění na úrovni 2.0 Ga

Evidence for global cooling comes from the first glacial deposits found in the rock record at **about 2.0 Ga** (**Gowgonda Tillite**, **Huronian Supergroup**, **Canada**).

Global cooling and the formation of high latitude ice sheets caused cold polar water to begin to flow through the deep ocean, mixing the formerly stratified water column. This **mixing and oxygenation of the deep ocean prevented the buildup of large amounts of iron** (iron released into the water was oxidized immediately and locally) and **shut down the production of BIFs**.



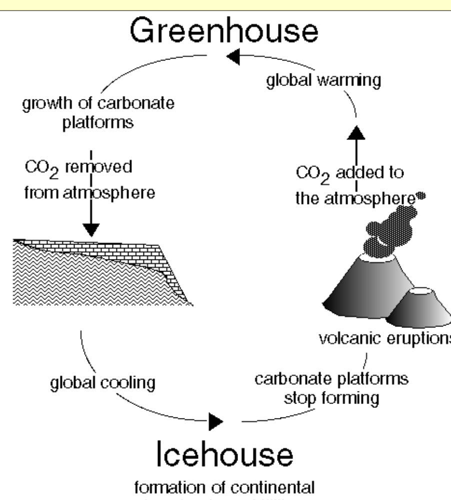
Pozdně proterozoické zalednění a ledničkový klimatický režim (Země jako sněhová koule / Snowball Earth/)

A second, apparently more extensive series of glaciations occurred in the **Late Proterozoic between about 850 and 600 Ma.** Glacial deposits from this age are found as a series of formations **on all continents** but Antarctica, suggesting a widespread and prolonged episode of cooling of the Earthâs climate.

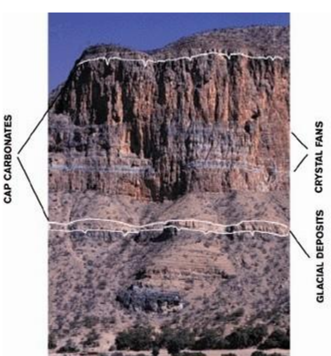
Even more remarkable is the fact that paleogeographic reconstructions for this time suggest that most continents were in **low latitude**, equatorial positions. Glaciers do not usually form in equatorial regions except at high altitudes. The presence of thick deposits of **carbonates** (developed in equatorial to subtropical oceans) interlayered with glacial **tillites** (found in the Rapitan Group of the Canadian Cordillera and in Namibia) argues strongly for a rapidly shifting climate that brought glacial conditions almost to the equator. Such an extreme icehouse climate may have been triggered by the presence of so much highly reflective **landmass distributed across the equator** (equatorial oceans are much better collectors of solar heat) combined with extensive carbonate shelves drawing CO2 out of the atmosphere.

Skleníkový (greenhouse) a chladničkový (icehouse)

klimatický režim Země



"Snowball" Earth

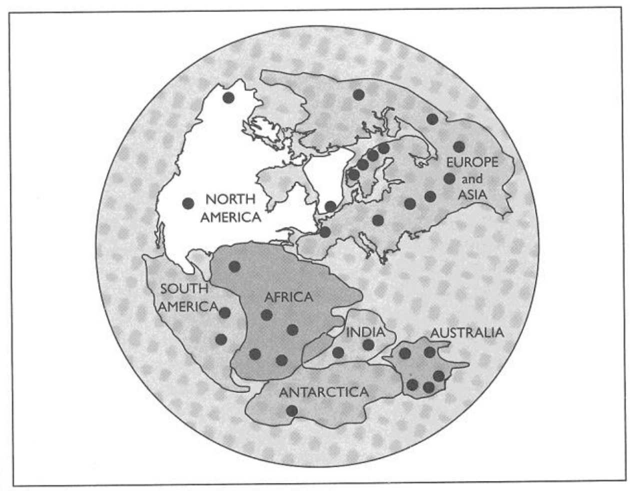


Glacigenní tillity v přímém nadloží tropických vápenců (nyní dolomity)

Dropstony napadané do souvrství BIF

Výskyty prekambrických glacigenních sedimentů

Figure 39 *The location of Precambrian glacial deposits.*



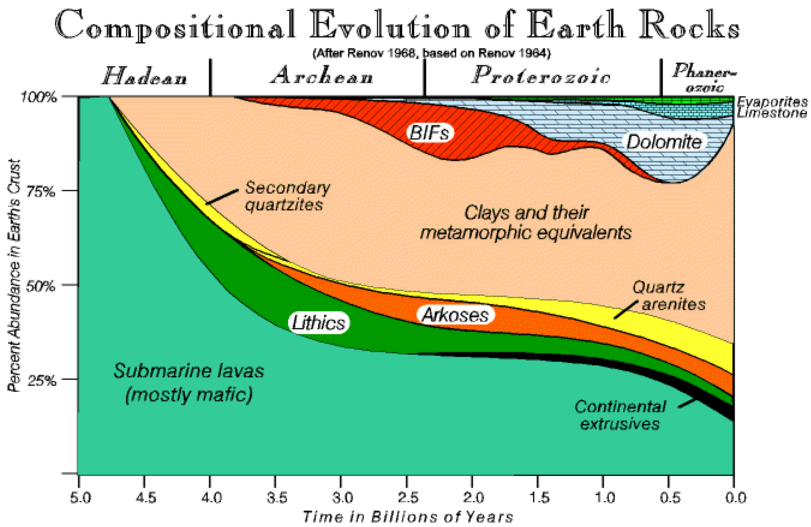
Horniny v proterozoiku

Granity a ruly jsou méně časté než v archaiku. **Hojné anortozity** An unusual type of plutonic rock called **anorthosite** is very common in the Proterozoic (in particular during the Grenville orogeny) but uncommon in earlier or later rocks. Anorthosite is composed of greater than 90 percent **plagioclase**, and represents a puzzle for geologists who study the origin of igneous rocks (igneous petrologists) because it requires very unusual conditions for its production in the mantle and emplacement in the crust.

Hojné šelfové sedimenty včetně **křemenných pískovců**, **vápenců**, **arkóz a břidlic**: are common in the Proterozoic as are deeper-water, poorly-sorted sandstones (graywackies).

Páskované železné rudy proterozoika představují **většinou světových zásob železné rudy**. These rocks are composed of alternating layers of hematite (Fe_2O_3)and quartz (SiO_2)precipitated in the marine environment. One suggestion is that they represent a mechanism by which primitive life, for which oxygen was a poison, was able to remove oxygen from the environment. the hematite layers are **sinks for excess oxygen** while the quartz layers represent a silica gel in which these organisms lived.

Komatiity a alkalické lávy jsou v proterozoiku vzácné. V proterozoiku jsou vzácné **sádrovce** ($CaSO_4.H_2O$) a **anhydrity** ($CaSO_4$), které vyžadují vyšší množství kyslíku, než kolik ho bylo v proterozoické atmosféře a oceánech.



Oxidační krize v úrovni 2,2 Ga

Rychlé zvýšení koncentrace kyslíku v atmosfěře

The first "**pollution crisis**" hit the Earth about **2.2 billion years ago**. Several pieces of evidence -- the presence of iron oxides in paleosols (fossil soils), the appearance of "red beds" containing metal oxides, and others -- point to a fairly **rapid increase in levels of oxygen in the atmosphere** at about this time. Oxygen levels in the **Archaean had been less that 1% of present levels** in the atmosphere, but by about **1.8 billion years ago, oxygen levels were greater than 15%** of present levels and rising. (Holland, 1994) It may seem strange to call this a "pollution crisis," since most of the organisms that we are familiar with not only tolerate but require oxygen to live. However, oxygen is a powerful degrader of organic compounds. Even today, many **bacteria and protists are killed by oxygen**. Organisms had to evolve biochemical methods for rendering oxygen harmless; one of these methods, **oxidative respiration**, had the advantage of producing large amounts of energy for the cell, and is now found in most eukaryotes.

Kyslík je vedlejším produktem fotosyntézy cyanobaktérií

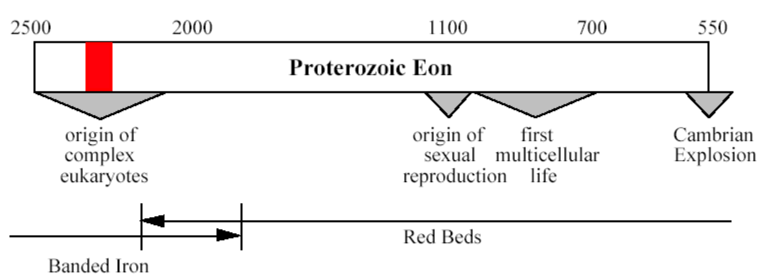
Where was this oxygen coming from? Cyanobacteria, photosynthetic organisms that produce oxygen as a byproduct, had first appeared 3.5 billion years ago, but became common and widespread in the Proterozoic. Their **photosynthetic activity** was primarily responsible for the rise in atmospheric oxygen.

SEDIMENTÁRNÍ HORNINY:

•1. **Mělkomořské kvarcity, karbonáty a jílovce**
•REPRESENT DEPOSITION ON & AT PASSIVE CONTINENTAL MARGINS OF WIDESPREAD STABLE CRATONS

•2. **Tillity a diamiktity** (valounové jílovce)
•REPRESENT **TWO** (2) EPISODES OF CONTINENTAL GLACIATION
•Late Archean/Early Proterozoic (2700-2300 my ago) - Bruce & Gowganda sequences in North America; numerous localities elsewhere
•Late Proterozoic (900-600 my ago) globally, even on continents along the equator!

•3. **Železné rudy**
•RECORD CHANGING OXYGEN CONTENT OF ATMOSPHERE
•Atmospheric oxygen content is a balance between sources & sinks
•*main source of oxygen is photosynthetic organisms, which developed in the Archean* [~*3.5 by ago*]
•*main sink for oxygen during the Archean & Earliest Proterozoic was previously dissolved iron* (*Fe+2*)
•*main sink for oxygen after the Latest Early Proterozoic* (*from ~2000 my ago to the present*) *has been weathering of iron-rich rocks*
•Latest Archean/Earliest Proterozoic - **Banded Iron Formations** **(BIFs)** [iron oxide & chert] {mostly (92%) Earliest Proterozoic}
•*Archean & Earliest Proterozoic oxygen combined with previously dissolved iron (Fe+2) to form BIFs & did NOT accumulate in the atmosphere*
•*By the end of Early Proterozoic time, the iron sink was used up & free oxygen began to accumulate in the atmosphere*
•Latest Early Proterozoic to the present (after 1800 my) - **Redbeds**
•*Redbeds result from hematite produced during weathering of iron-rich rocks in an oxidizing atmosphere*



All dates are in millions of years ago, M.y.a.

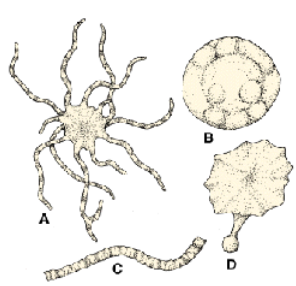
1. Život v proterozoiku
rozsáhlé stromatolity.
May have been more resistant to UV radiation because of sediment covering.
Presence of stromatolites and blue-green algae (photosynthetic) led to buildup of oxygen in atmosphere.
Gunflint chert (Ontario, Canada, 1.9 by) contains extensive remains of **prokaryotic organisms** including bacteria and algal filaments

První fosilní eukaryontní buňky se objevují minimálně 2,1 Ga.
Eukaryotes are cells which have a nucleus and organelles. They are larger than prokaryotes. Reproduce through mitosis and meiosis
i. First fossil cells with what appear to be organelles
1.8 - 1.2 by
ii. Bitter Springs Fm, chert, Australia
0.8 - 0.9 by
impressive eukaryote fossils

První fosilní stopy (ichnofosílie) indicate the presence of multicellular organisms.
oldest are about **0.7 Ga (700 ma)**

První mnohobuněčné organismy= Ediakarská fauna Metazoans appeared in the Late Proterozoic. Metazoans are multicellular animals with various types of cells organized into tissues and organs. Metazoans lived during the Vendian (the end of the Late Proterozoic), and first appeared about 630 my ago (0.63 by). What stimulated the appearance of metazoans? May be related to the accumulation of oxygen in the atmosphere.

Malé organismy s pevnými schránkami (rozměry několik mm) appeared in the Late Proterozoic late Proterozoic small fossils with shells include possible primitive molluscs, sponge spicules, tubular or cap-shaped shells, and tiny tusk-shaped fossils called hyoliths. Early shelly material is made of calcium carbonate and calcium phosphate.

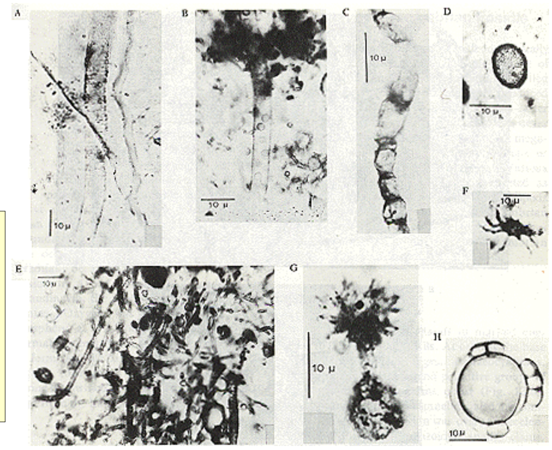


Prokaryonta z Gunflintské skupiny (BIF)

The **Gunflint Chert**, within the BIF sequence, contains **fossil remains of prokaryotic organisms**, including cyanobacteria. Age = 1.9 by.
Diagrams of organisms in the Gunflint Chert.
*A = **Eoastrion** (= dawn star), probably iron- or magnesium-reducing bacteria*
*B = **Eosphaera**, an organism or uncertain affinity, about 30 micrometers in diameter*
*C = **Animikiea** (probably algae)*
*D = **Kakabekia**, an organism or uncertain affinity*

Fosílie Gunflintské skupiny

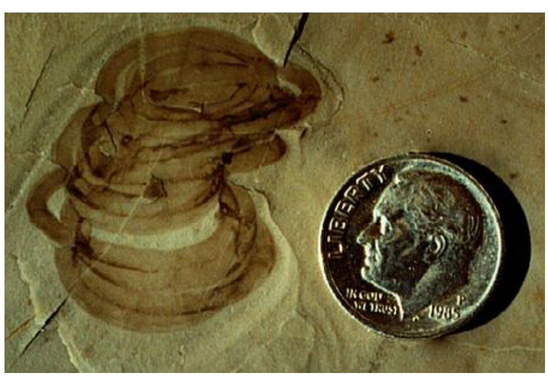
A-C. blue-green algae; *Animikia, Entosphaeroides,* and *Gunflintia; D. Huroniospora,* an algal spore; *E. Gunflintia* and *Hurionospora; F. Euastrion,* a bacterium, and enigmatic forms, *G. Kakabekia; H. Eosphaera*



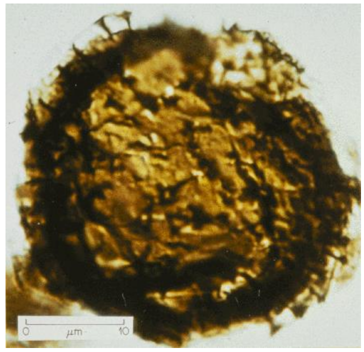
Prekambrické **vláknité cyanobakterie** (Nostocales) z formace **Bitter Springs v Centrální Austrílii, 850 Ma**. Optical photomicrographs showing eceptionally well preserved Oscillatoriacean, Nostocacean and, possibly, Rivulariacean trichomes in petrographic thin sections of Black chert

EUKARYONTNÍ BUŇKY.
SYMBIÓZA = The mutually beneficial relationship between two individuals or two species. Both individuals, or the members of both species benefit more or less equally from their association.
Advantages that Eukaryotic cells might have in some environments.
Pravděpodobná sexuální reprodukce— this provides opportunity for greater standing crop of genetic and thus phenotypic variation.
Možnost větší diferenciace DNA — more DNA allows for more complicated array of genes through mutation and recombination.
Zvýšená produkce energie. Have specialized organelles to provide lots of ATP — mitochondrion.
May have been unable to diversity until oxygen levels reached a critical threshold

PREKAMBRICKÁ EUKARYOTA
They are now thought to have originated much earlier than paleontologists have previously thought.
PRVNÍ EUKARYOTA
Nejstarší cca **2.1 MILIARD** let.
These first fossils that are certainly eukaryotic are those of an algal form called ***Grypania spiralis***. They are found in filaments.
ACRITARCHS
CHITINOZOANS

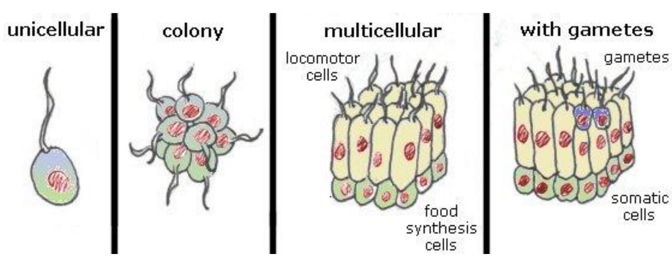


Gryphania spiralis



11. Acritarch: *Vandalosphaeridium walcottii*, a spiny acritarch from a palynological preparation of carbonaceous mudstone of the Awatubi Member, Kwagunt Formation, Chuar Group of the Grand Canyon. Late Precambrian, 850 million years old.

Acritarchs first appear in the rock record about 1.6 billion years ago. Theyprobably represent a group of planktic algae, and they are considered the first eucaryotic cells because of their larger size and more complex, ornamented outer wall.



MNOHOBUNĚČNÉ ORGANISMY
Multicellularism probably arose as unicellular ancestors (unicellular green algae like the biflagellated *Chlamydomonas*) joined into loose colonies, probably taking a form similar to *Volvox*-a hollow, fluid-filled ball similar to the blastocyst stage in animal development. The cells in this colony may then have become more specialized for singular functions, and thus dependent on each other. For instance, cells that kept a flagellum could have assumed responsibility for the locomotion of the colony, while other cells could have assumed digestive or metabolic tasks, and others could have been specialized for gamete production. The evolution of multicellularism is diagrammed to the left.

The first fossilized evidence of multi-cellular cells goes back to about 1.5 billion years ago.

EDIAKARSKÁ FAUNA (BIOTA)

Nejstarší výskyty **mnohobuněčných živočichů**
- 700 - 545 Ma.
- nalziště Pound Fm., u města Ediacara, Jižní Austrálie

Ediacara biota known from occurrences on most continents

Biota consists of soft-bodied metazoans, preserved as impressions in sandstone and shales

Includes:

•jellyfish-like forms (common)

•worm-like forms

•possible molluscs

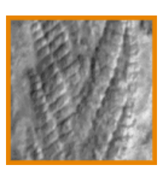
•possible arthropods

•possible echinoderms

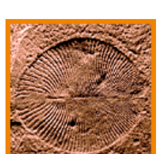
•large, flat forms of unknown affinities

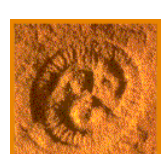
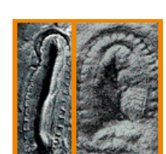
VENDOBIONTA

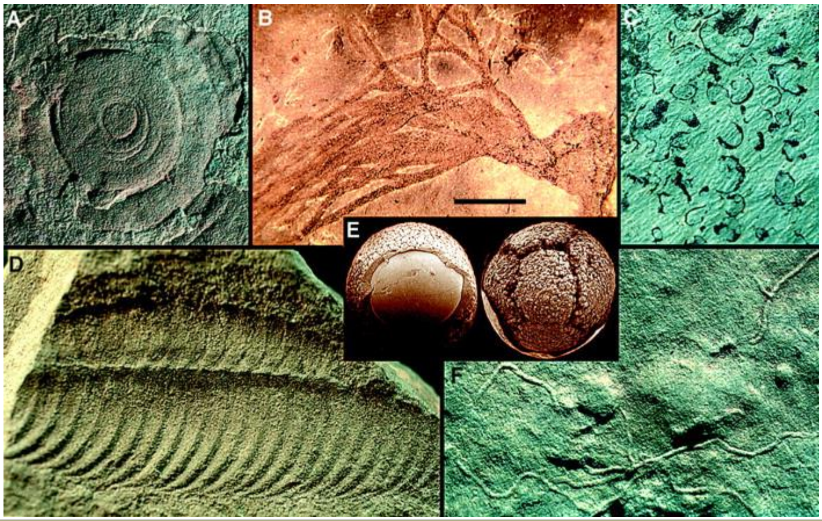
There are hints from trace fossils and molecular biology that animals may have appeared as much as **1 billion years** ago. However, the oldest relatively non-controversial, well-studied animal fossils appear in the last hundred millions of years of the Proterozoic, just before the Cambrian radiation of taxa.
For some years a number of authors (*e.g.* Seilacher 1984, McMenamin 1986) have argued that the Ediacarans were **unrelated to any living group of organisms**; that they represented a new kingdom (**Vendobionta** Seilacher 1992) which disappeared around the Vendian-Cambrian boundary, perhaps wiped out by a mass extinction event. However, this view has always encountered opposition and now appears to have lost much of its support.



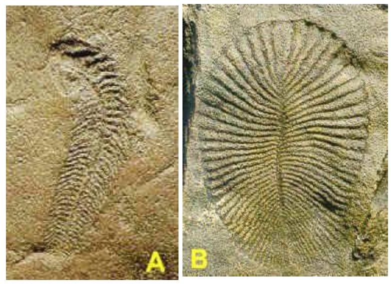


The nature of the terminal Proterozoic fossil record. (**A**) *Ediacaria*, a radially symmetrical cast preserved on the underside of a sandstone bed, Rawnsley Quartzite, South Australia. (**B**) Macroscopic alga preserved as a carbonaceous compression in shales of Doushantuo Formation, China. (**C**) Calcified fossils in limestones of the Nama Group, Namibia. (**D**) *Pteridinium*, a frondose Ediacaran fossil consisting of three vanes built of repeating units (two visible in specimen) that are joined along a central axis. (**E**) Phospatized animal egg and early cleavage-stage embryo, Doushantuo Formation. (**F**) Simple trace fossils of bilaterian animals, Rawnsley Quartzite. Bar = 2.5 cm for (A), 3 mm for (B), 1.5 cm for (C) and (D), 250 µm for (E), and 2 cm for (F).

1. **Oldest Metazoan Body Fossils = EDIACARA FAUNA**
2. **Originally discovered in Pound Qtzt, Ediacara Hills, S. Australia; later found worldwide (including Piedmont area of NC) at low paleolatitudes.**
   0.59 - 0.7 by (590 - 700 my)
   impressions and molds of animals (associated with trace fossils)

1. ***Tribrachidium heraldicum*, Echinoderm?, from Australia**

Dickinsonia



Examples Of The Ediacaran Fauna
A. Genus *Spriggina*. *B.* Genus Dickinsonia.
These bodies of these spe*cimens are preserved as* ***impressions*** *in fine grained sandstone of the Pound Quartzite (Ediacaran age, Australia). Similar appearing, soft-bodied fossils are known from over two dozen localities worldwide. These organisms were all small, had thin bodies with a quilted outer surface, and lacked any internal or external hard parts.* Specimens about 4 to5 cm in length.

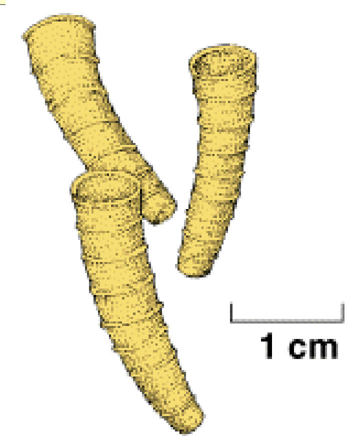
1. ***Tribrachidium heraldicum*, Echinoderm?, from Australia**

1. **Unnamed "spindle-shaped organism" from Newfoundland**

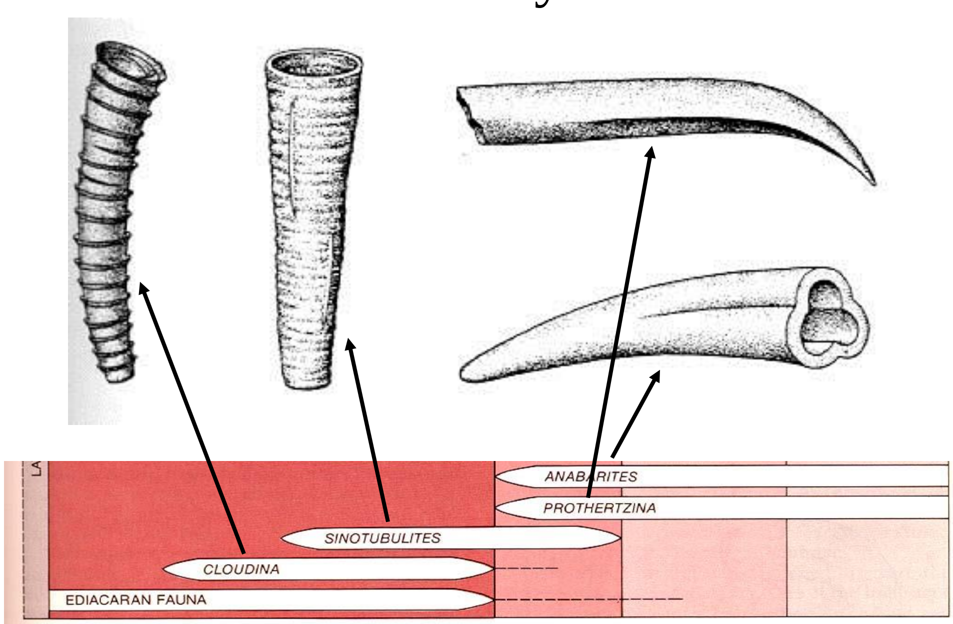
První fauna s pevnými schránkami (Small Shelly Fauna)

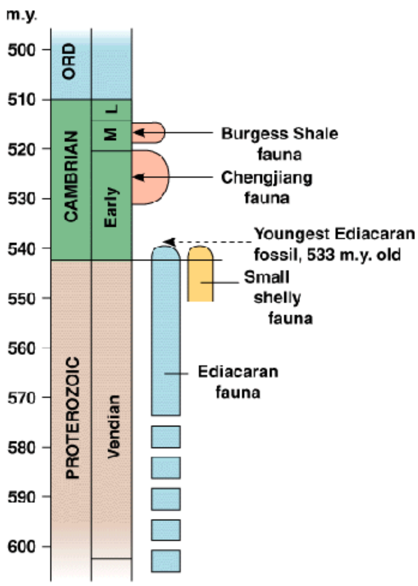
Původ pevných (mineralizovaných) schránek
Small fossils with hard parts or shells (mostly a few mm long) appeared in the Vendian (see yellow bar on time scale above).

Cloudina, an organism with a small (few cm long), tubular shell of calcium carbonate is interpreted as a tube-dwelling worm. It is the earliest known organism with a $CaCO_3$ shell. Found in Namibia, Afric

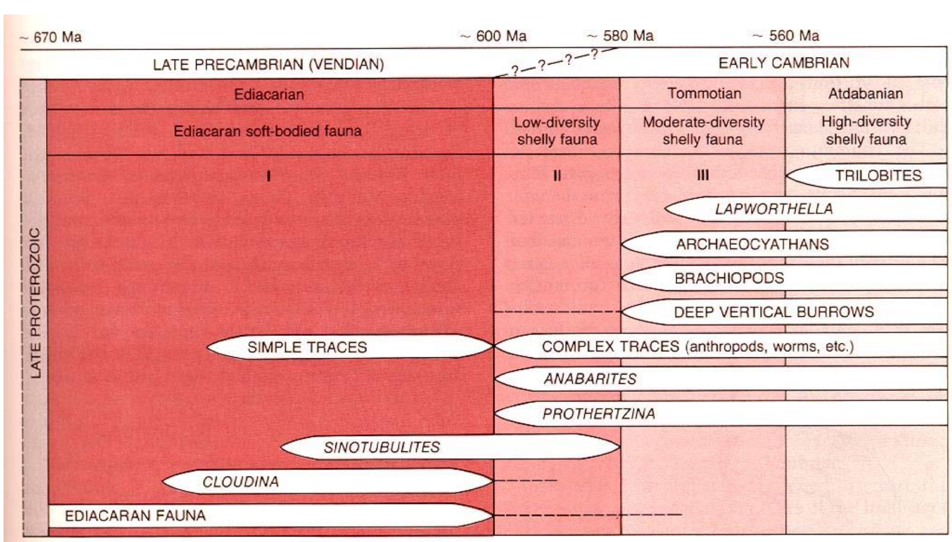


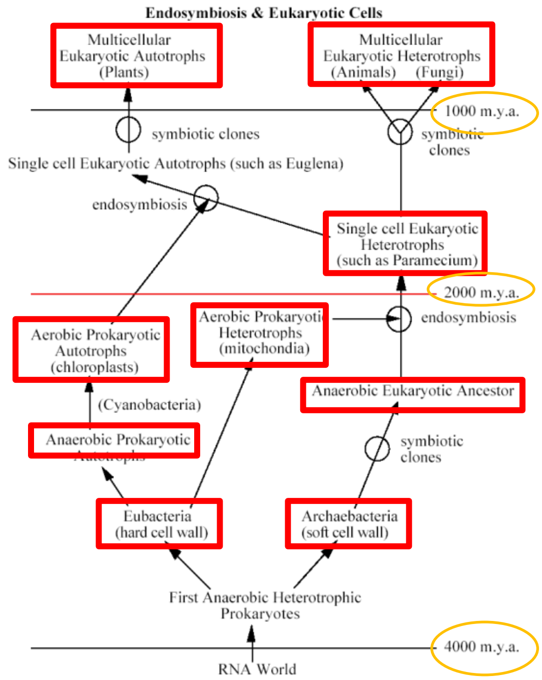
Small Shelly Fauna



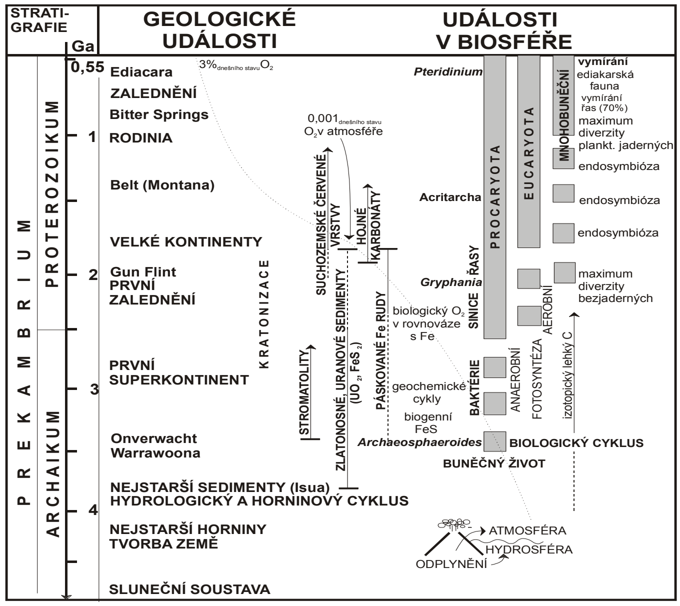


Cambrian-Precambrian Transition




Endosymbiosis & Eukaryotic Cells
Multicellular Eukaryotic Autotrophs (Plants)
Multicellular Eukaryotic Heterotrophs (Animals) (Fungi)
1000 m.y.a.
symbiotic clones
symbiotic clones
Single cell Eukaryotic Autotrophs (such as Euglena)
endosymbiosis
Single cell Eukaryotic Heterotrophs (such as Paramecium)
2000 m.y.a.
Aerobic Prokaryotic Autotrophs (chloroplasts)
Aerobic Prokaryotic Heterotrophs (mitochondia)
endosymbiosis
Anaerobic Eukaryotic Ancestor
(Cyanobacteria)
Anaerobic Prokaryotic
symbiotic clones
Eubacteria (hard cell wall)
Archaebacteria (soft cell wall)
First Anaerobic Heterotrophic Prokaryotes
4000 m.y.a.
RNA World

Hlavní geologické a biologické události v archaiku a proterozoiku. (upraveno dle různých pramenů)



Regionální výskyt

Orogény svrchního proterozoika

Late Proterozoic "mobile belts" (orogens)

- a supercontinent formed in the Neoproterozoic (Rodinia)
- pan-African orogeny (ca. 950-450 Ma)
  - very long-lasting, certainly diachronous, maybe multiple events, many areas not well dated
  - clear evidence for modern-style plate tectonics
  - ophiolites, calc-alkaline batholiths, major horizontal displacements, flysch and molasse
  - also much granulite facies metamorphism (extensive uplift after continental collision?)
- Pan-African is best developed in East Africa
  - also includes West African orogens (Dahomeyan-Pharusian)
  - Braziliano (Brazil)
  - Cadomian (Europe)
  - Avalonian?

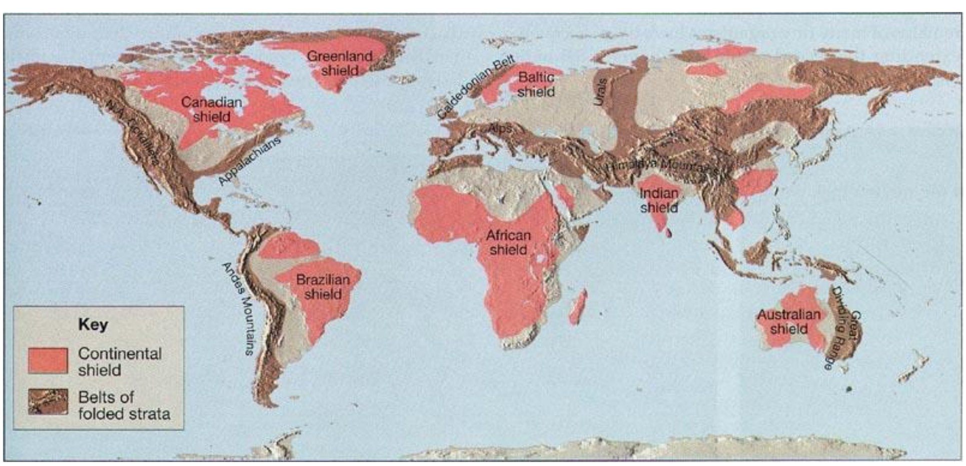
Grenvillská orogeneze

Mesoproterozoic mountain-building event (circa 1250-980 Ma)

assembly of the supercontinent Rodinia.

a prominent orogenic belt which spans a significant portion of the North American continent, from Labrador to Mexico, as well as to Scotland.

These events are known as the Kibaran orogeny in Africa, the Dalslandian orogeny in western Europe.



- Proterozoický vývoj Evropy a Českého masívu

Východoevropský kraton

Fennoscandie – tvořena baltickým štítem a přilehlou platformou

Sarmatie

Volžsko.-uralská oblast

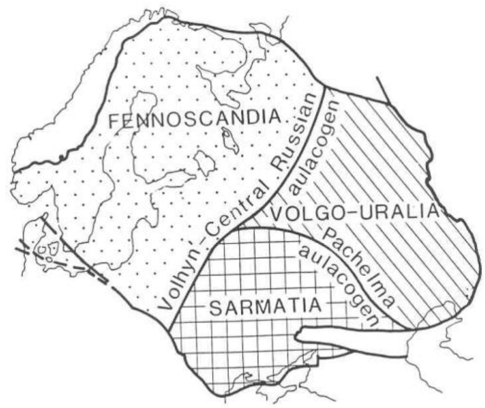


Fig. 2 Crustal segments of the East European Craton seperated by Paleozoic rifts. Here, Fennoscandia applies to the Baltic Shield and its buried equivalent [Gorbatshcev, 1993 #6].

Fennoscandia (baltický štít)

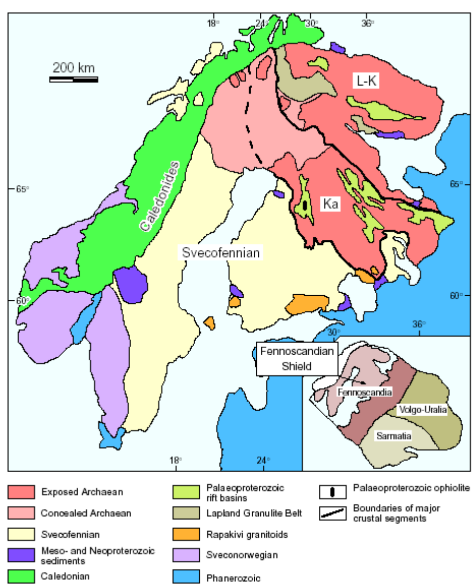


Figure 5.1: Simplified geological map of the Baltic Shield and surroundings (modified from Boyd et al., 1985 and Öhlander et al., in Gorbatschev, 1993; inset showing the subdivision of the East-European Craton from Gorbatschev and Bogdanova, in Gorbatschev, 1993). Generalized tectonic boundaries between the Lapland-Kola Orogen (L-K) and the Karelian Province (Ka) and between the latter and the Svecofennian Orogen are shown as heavy lines, dashed to indicate greater uncertainty. Proterozoic rift basins are omitted in the region labelled 'concealed Archaean'.

Prekambrické kolizní události Fennoscandie

Saamská orogeneze	cca 3 Ga	kolize svekobaltského(SVK) a karelského kontinentu(KK)
Kuhmo-belomorská orogeneze	2,8 Ga	Wilsonův cyklus mezi SVK a KK

Sfekobaltská orogeneze	2,2 Ga	další Wilsonův cyklus mezi SVK a KK
Sfekofenská orogeneze	2,0 Ga	další Wilsonův cyklus mezi SVK a KK
Gotská orogeneze	1,7-1,5	?? Akrece oblouků, mikrokontinentu, Amazonie
Sfekonorvegská orogeneze	1,0	kolize s Laurentii

Konsolidace východoevropského kratonu

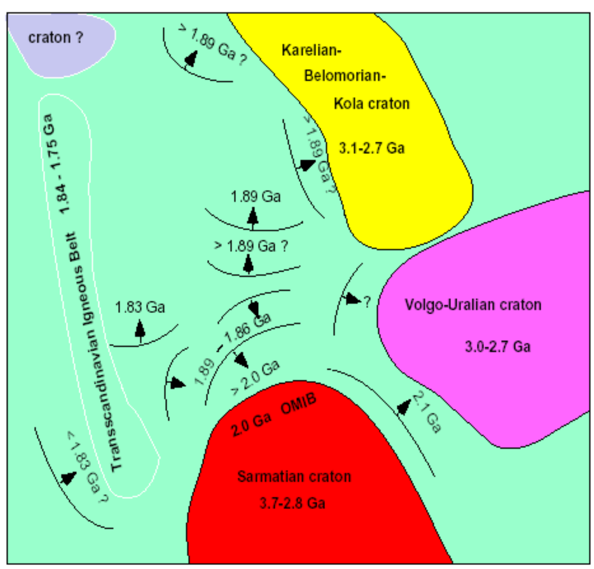


Figure 7.3: Sketch showing the axes of Svecofennian magmatic arcs and the times of Palaeoproterozoic accretion in the western part of the East-European Craton.

Český masiv

Představuje hrásťovou strukturu variského orogenu ovlivněnou alpínskou orogenezí. Období proterozoika a paleozoika formovaly území Českého masívu dvě orogeneze, někdy také označované jako geotektonické cykly:

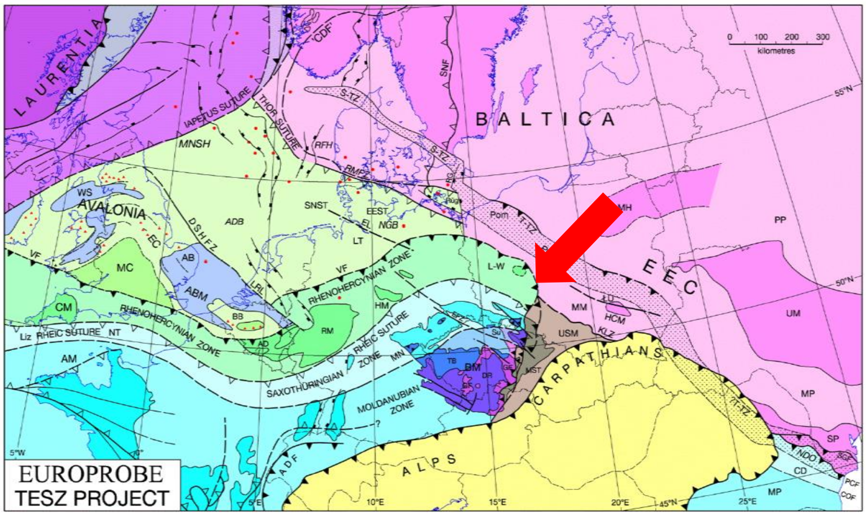
•**kadomský**

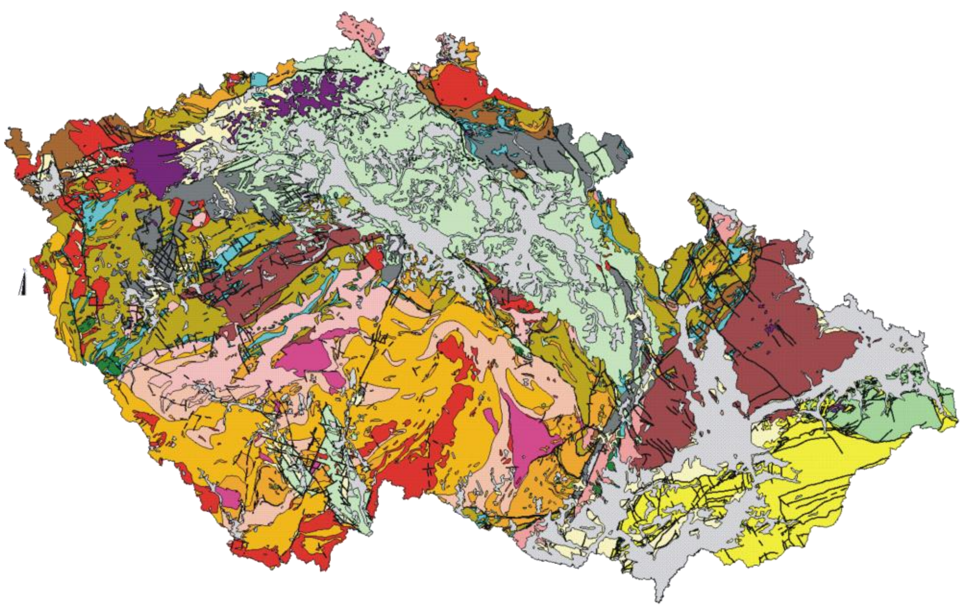
v podstatě vytvořil původní stavbu Českého masívu, dnes jsou produkty kadomské orogeneze (obr. 41) zachovány nejlépe v moravsko-slezské (např. brněnský masív) a lugické oblasti (lužický pluton)

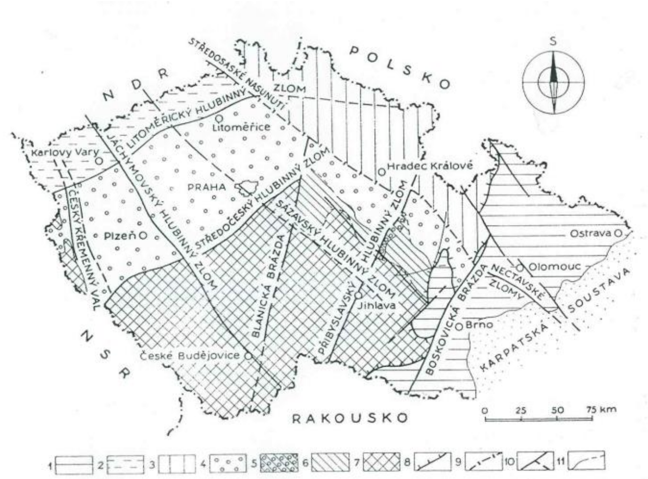
•**variský (někdy označovaný jako hercynský)**

výrazně přetvořil především centrum Českého masívu - spojen s metamorfními pochody v celé oblasti a vznikem velkých těles vyvřelých hlubinných hornin, např. centrální masív moldanubika a středočeský pluton (obr. 42).

Poslední orogeneze **alpínská** Český masív jen ovlivnila, ale nepřetvořila. Způsobila tektonické pohyby bloků podél hlubinných zlomů, které se označují jako ***saxonská tektonika.***


LAURENTIA
BALTICA
AVALONIA
EEC
CARPATHIANS
ALPS
RHENOHERCYNIAN ZONE
SAXOTHURINGIAN ZONE
MOLDANUBIAN ZONE
RHEIC SUTURE
IAPETUS SUTURE
THOR SUTURE
EUROPROBE
TESZ PROJECT





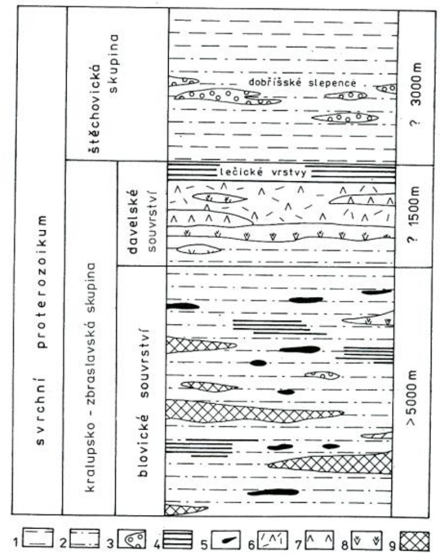
4 Základní rozdělení Českého masívu na oblasti na území ČSSR a nomenklatura používaná dále v textu (orig.); 1 moravskoslezská oblast, 2 krušnohorská oblast, 3 lugická oblast, 4 středočeská oblast, 5 hlinská zóna středočeské oblasti, 6 kutnohorsko-svratecká oblast, 7 moldanubická oblast, 8 moravskoslezské zlomové pásmo, 9 jižní okraj lugické oblasti, 10 základní zlomy důležité pro vymezení oblastí, 11 hranice oblastí

Vývoj Českého masívu je dělen na dvě etapy:
•**předplatformní,** tzn. do úplného skončení variského geotektonického cyklu (konec prvohor). K předplatformním krystalinickým jednotkám a zvrásněnému paleozoiku se řadí:
•**moldanubická oblast**
•**kutnohorsko-svratecká oblast**
•**středočeská oblast**
•**krušnohorská oblast**
•**lugická oblast**
•**moravsko-slezská oblast**
Zvláštní postavení mají **sedimenty limnického permokarbonu**, které tvoří přechod mezi předplatformním a platformním vývojem Českého masívu (v počátcích jejich sedimentace ještě doznívaly poslední pohyby patřící do variského geotektonického cyklu).
•**platformní** - celá oblast je stabilní a postupně ji překrývají pouze další komplexy sedimentárních hornin. K platformním jednotkám patří**:**
•**jura**
•**křída**
•**terciér**
•**kvartér**

Středočeská oblast

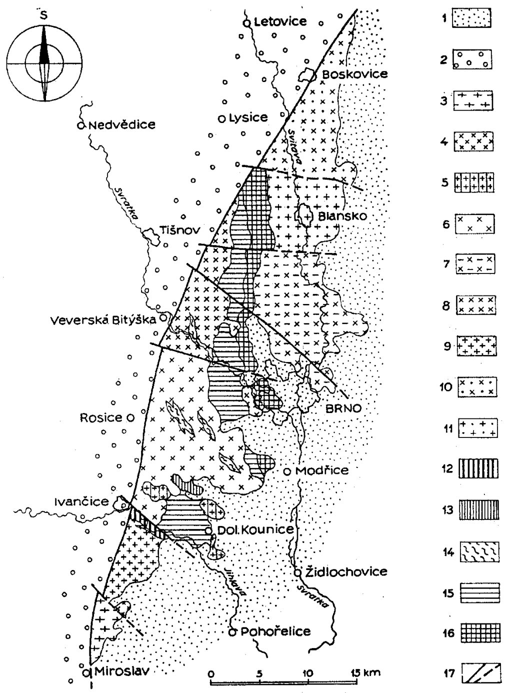
•klastické sedimenty
•polohy kyselých a intermediárních vulkanitů
•bazické vulkanity („spility“)
•Rohovce (silicity) „buližníky“

•Kralupsko-zbraslavská skupina
•Štechovická skupina



Obr. 4. Stratigrafické schéma proterozoika Barrandienu (podle J. Maška 1982).
1 – střídání prachovců a jílových břidlic; 2 – střídání prachovců, drob a jílových břidlic; 3 – s
ce; 4 – černé břidlice; 5 – buližníky; 6 – pyroklastika kyselých a intermediálních vulkanitů;
selé vulkanity; 8 – intermediální vulkanity; 9 – bazické vulkanity („spility“).

18



•**Brunovistulikum**
Je to velká krystalinická jednotka tvořená převážně hlubinnými magmatickými horninami a částečně metamorfity, která se nachází v podloží téměř celé Moravy a Slezska. Z větší části je zakryta sedimentárními horninami. Na východ se brunovistulikum noří pod karpatské příkrovy a jeho východní okraj není znám. Na povrch vystupuje jako brněnský masív a drobná tělesa granitoidů v okolí Olomouce.